The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An electrodeposition process for producing a layered composite material comprised of layers of an alloy, the process using an electroplating circuit comprising a power supply, an electroplating solution comprising ions of the elements comprising the alloy, and an electrodeposition substrate, the process comprising the following steps:

(a) first energizing the electroplating circuit with the power supply to provide a first electroplating current in the electroplating circuit during a first current plating time interval to deposit a layer of a first alloy species of the alloy on the substrate, the first alloy species having first alloy species properties; and

(b) second energizing the electroplating circuit with the power supply to provide a second electroplating current in the electroplating circuit during a second current plating time interval to deposit a layer of a second alloy species of the alloy on the substrate, the second alloy species having second alloy species properties;

wherein the first alloy species properties are distinguishable from the second alloy species properties.

2. The process as claimed in claim 1 wherein the first electroplating current is selected so that the first alloy species consists essentially of a first alloy phase.

3. The process as claimed in claim 1 wherein the second electroplating current is selected so that the second alloy species consists essentially of a second alloy phase.

4. The process as claimed in claim 2 wherein the second electroplating current is selected so that the second alloy species consists essentially of a second alloy phase.

5. The process as claimed in claim 4 wherein the first alloy phase has a first alloy phase composition, wherein the second alloy phase has a second alloy phase composition, and wherein the first alloy phase composition is different from the second alloy phase composition.

6. The process as claimed in claim 5 wherein the first current plating time interval and the second current plating time interval are selected so that the layered composite material has a desired composite material composition.

7. The process as claimed in claim 6 wherein the first electroplating current is a direct current.

8. The process as claimed in claim 6 wherein the second electroplating current is a direct current.

9. The process as claimed in claim 7 wherein the second electroplating current is a direct current.

10. The process as claimed in claim 6 wherein the first electroplating current is a pulsed current.

11. The process as claimed in claim 6 wherein the second electroplating current is a pulsed current.

12. The process as claimed in claim 10 wherein the second electroplating current is a pulsed current.

13. The process as claimed in claim 6 wherein the alloy is comprised of gold and tin.

14. The process as claimed in claim 13 wherein the first alloy phase is Au_5Sn and wherein the second alloy phase is AuSn.

15. The process as claimed in claim 14 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of between about 25 at % tin and about 40 at % tin.

16. The process as claimed in claim 15 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of between about 27 at % tin and about 35 at % tin.

17. The process as claimed in claim 16 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of about 30 at % tin.

18. The process as claimed in claim 16 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is a eutectic composition.

19. The process as claimed in claim 14 wherein the first electroplating current is a pulsed current and has an average current density at the substrate of less than or equal to about 1 mA/cm^2.

20. The process as claimed in claim 14 wherein the second electroplating current is a pulsed current and has an average current density at the substrate of greater than or equal to about 2 mA/cm^2.

21. The process as claimed in claim 19 wherein the second electroplating current is a pulsed current and has an average current density at the substrate of greater than or equal to about 2 mA/cm^2.

22. The process as claimed in claim 21 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of between about 25 at % tin and about 40 at % tin.

23. The process as claimed in claim 22 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of between about 27 at % tin and about 35 at % tin.

24. The process as claimed in claim 23 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of about 30 at % tin.

25. The process as claimed in claim 23 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is a eutectic composition.

26. The process as claimed in claim 21 wherein the first electroplating current is a direct current.

27. The process as claimed in claim 21 wherein the second electroplating current is a direct current.

28. The process as claimed in claim 26 wherein the second electroplating current is a direct current.

29. The process as claimed in claim 21 wherein the first electroplating current is a pulsed current.

30. The process as claimed in claim 21 wherein the second electroplating current is a pulsed current.

31. The process as claimed in claim 29 wherein the second electroplating current is a pulsed current.

32. The process as claimed in claim 31 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of between about 25 at % tin and about 40 at % tin.

33. The process as claimed in claim 32 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of between about 27 at % tin and about 35 at % tin.

34. The process as claimed in claim 33 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of about 30 at % tin.

35. The process as claimed in claim 33 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is a eutectic composition.

36. The process as claimed in claim 31 wherein the first electroplating current has an on-time of at least about 2 milliseconds per pulse cycle and wherein the second electroplating current has an on-time of at least about 2 milliseconds per pulse cycle.

37. The process as claimed in claim 36 wherein the first electroplating current has an off-time of at least about 4 milliseconds per pulse cycle and wherein the second electroplating current has an off-time of at least about 4 milliseconds per pulse cycle.

38. The process as claimed in claim 37 wherein the first electroplating current has a pulse cycle period of about 10 milliseconds and wherein the second electroplating current has a pulse cycle period of about 10 milliseconds.

39. The process as claimed in claim 38 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of between about 25 at % tin and about 40 at % tin.

40. The process as claimed in claim 39 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of between about 27 at % tin and about 35 at % tin.

41. The process as claimed in claim 40 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is comprised of about 30 at % tin.

42. The process as claimed in claim 40 wherein the first current plating time interval and the second current plating time interval are selected so that the composite material composition is a eutectic composition.

43. The process as claimed in claim 38 wherein the first electroplating current has a pulse cycle period of about 10 milliseconds and an on-time of about 2 milliseconds per pulse cycle and wherein the second electroplating current has a pulse cycle period of about 10 milliseconds and an on-time of about 2 milliseconds per pulse cycle.

44. The process as claimed in claim 6 wherein the first energizing step and the second energizing step are repeated in sequence so that the layered composite material is comprised of a plurality of layers of each of the first alloy species and the second alloy species.

45. The process as claimed in claim 14 wherein the electroplating solution is comprised of ammonium citrate, a salt of gold which is soluble in ammonium citrate, and a salt of tin which is soluble in ammonium citrate.

46. The process as claimed in claim 45 wherein the electroplating solution is further comprised of a gold stabilizer and a tin stabilizer.

47. The process as claimed in claim 46 wherein the gold salt is potassium gold chloride and wherein the tin salt is tin chloride.

48. The process as claimed in claim 47 wherein the gold stabilizer is comprised of sodium sulphite.

49. The process as claimed in claim 48 wherein the tin stabilizer is comprised of L-ascorbic acid.

50. The process as claimed in claim 49 wherein the first energizing step and the second energizing step are repeated in sequence so that the layered composite material is comprised of a plurality of layers of each of the first alloy species and the second alloy species.

51. The process as claimed in claim 21 wherein the electroplating solution is comprised of ammonium citrate, a salt of gold which is soluble in ammonium citrate, and a salt of tin which is soluble in ammonium citrate.

52. The process as claimed in claim 51 wherein the electroplating solution is further comprised of a gold stabilizer and a tin stabilizer.

53. The process as claimed in claim 52 wherein the gold salt is potassium gold chloride and wherein the tin salt is tin chloride.

54. The process as claimed in claim 53 wherein the gold stabilizer is comprised of sodium sulphite.

55. The process as claimed in claim 54 wherein the tin stabilizer is comprised of L-ascorbic acid.

56. The process as claimed in claim 55 wherein the first energizing step and the second energizing step are repeated in sequence so that the layered composite material is comprised of a plurality of layers of each of the first alloy species and the second alloy species.

57. The process as claimed in claim 31 wherein the electroplating solution is comprised of ammonium citrate, a salt of gold which is soluble in ammonium citrate, and a salt of tin which is soluble in ammonium citrate.

58. The process as claimed in claim 57 wherein the electroplating solution is further comprised of a gold stabilizer and a tin stabilizer.

59. The process as claimed in claim 58 wherein the gold salt is potassium gold chloride and wherein the tin salt is tin chloride.

60. The process as claimed in claim 59 wherein the gold stabilizer is comprised of sodium sulphite.

61. The process as claimed in claim 60 wherein the tin stabilizer is comprised of L-ascorbic acid.

62. The process as claimed in claim 61 wherein the first energizing step and the second energizing step are repeated in sequence so that the layered composite material is comprised of a plurality of layers of each of the first alloy species and the second alloy species.

63. The process as claimed in claim 38 wherein the electroplating solution is comprised of ammonium citrate, a salt of gold which is soluble in ammonium citrate, and a salt of tin which is soluble in ammonium citrate.

64. The process as claimed in claim 63 wherein the electroplating solution is further comprised of a gold stabilizer and a tin stabilizer.

65. The process as claimed in claim 64 wherein the gold salt is potassium gold chloride and wherein the tin salt is tin chloride.

66. The process as claimed in claim 65 wherein the gold stabilizer is comprised of sodium sulphite.

67. The process as claimed in claim 66 wherein the tin stabilizer is comprised of L-ascorbic acid.

68. The process as claimed in claim 67 wherein the first energizing step and the second energizing step are repeated in sequence so that the layered composite material is comprised of a plurality of layers of each of the first alloy species and the second alloy species.

69. A layered composite material comprising a layer of a first alloy species of an alloy, the first alloy species having first alloy species properties, and further comprising a layer of a second alloy species of the alloy, the second alloy species having second alloy species properties, wherein the first alloy species properties are distinguishable from the second alloy species properties.

70. The layered composite material as claimed in claim 69 wherein the first alloy species consists essentially of a first alloy phase.

71. The layered composite material as claimed in claim 69 wherein the second alloy species consists essentially of a second alloy phase.

72. The layered composite material as claimed in claim 70 wherein the second alloy species consists essentially of a second alloy phase.

73. The layered composite material as claimed in claim 72 wherein the first alloy phase has a first alloy phase composition, wherein the second alloy phase has a second alloy phase composition, and wherein the first alloy phase composition is different from the second alloy phase composition.

74. The layered composite material as claimed in claim 73 wherein the alloy is comprised of gold and tin.

75. The layered composite material as claimed in claim 74 wherein the first alloy phase is Au_5Sn and wherein the second alloy phase is AuSn.

76. The layered composite material as claimed in claim 75 wherein the material has a composite material composition and wherein the composite material composition is comprised of between about 25 at % tin and about 40 at % tin.

77. The layered composite material as claimed in claim 76 wherein the composite material composition is comprised of between about 27 at % tin and about 35 at % tin.

78. The layered composite material as claimed in claim 77 wherein the composite material composition is comprised of about 30 at % tin.

79. The layered composite material as claimed in claim 77 wherein the composite material composition is a eutectic composition.

80. The layered composite material as claimed in claim 75 wherein the layered composite material is comprised of a plurality of layers of each of the first alloy species and the second alloy species.